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USER MANUAL

AFC123
PERSONAL AIR SAMPLER

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AFC123 HIGH FLOW PERSONAL SAMPLER.

1. Introduction.

The purpose of the instrument is to collect contaminate from air in the breathing zone of a person during a normal work period. The choice for sampling head and type of analysis give comparisons with occupational Exposure Limited or MAC values allowed by regulation.

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2. Principle Of Operation.

Air containing contaminate is drawn through the sampling head at the optimum rate found by experience. Suction is provided by a pump driven by a d.c. motor from a rechargeable nickel cadmium battery for up to 10 hours. Flow rate is variable by the user to suit the sampling technique.

The tough lightweight plastic case houses a diaphragm pump with motor, the electronic control board, the ON/OFF switch recessed into the case back, the battery pack and pulsation damper. The inlet to the damper contains a primary filter of sintered bronze to protect the pump if run without a sampling filter. The socket on the case side takes a plug for recharging the battery in-situ. The battery pack is easily changed for continuous shift working. One light emitting diode is seen through the case front, green to indicate pump running. Also fitted is a battery low cut-off, which will turn the pump off if it is inadvertently left running. This prevents the cells being damaged by deep discharge and also gives maximum life to the battery.

Size of sampler 120*75*44, mass of 440 grammes causes no significant handicap to wearer during work.

Note:- This leaflet describes how the sampler works and how to maintain it. It does not detail how to sample or analyse collected samples, or how to select methods for various hazards. Consult Occupational Health and Hygiene Division of Health and Safety Executive Research Association of the industry concerned, or an Advisory and Analytical Service.

Information on available sampling heads and accessories is given in a separate leaflet
HB3175/87.

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3. Operation.

The battery must be fully charged to ensure an 8 hour run, especially for filters giving a high initial pressure drop. The sampler is designed to work at a maximum efficiency within the flow rate of 1 to 2 litres/min. and to maintain the set flow rate within ±5% for pressure drop of up to 40cm H2O. At lower flow rates of the specified range down tom0.5 litres/min. the power limit will be reached at a drop of approximately 35cm H2O at this level the control limit will operate to switch the pump off. At flow rates approaching 2.5 litres/min. the control limit will not operate and will only maintain ±5% of present flow rate up to 25cm H2O.

Note:- The sampler should never be run without a filter on the inlet.

A suitable filter is put into the appropriate holder and is connected by a length of plastic tube to the inlet of the sampler. Switch the pump ON, slide the switch located in the recess at the back of the case. The green light indicates the pump is running. Setting of the flow rate is by adjustment of the potentiometer marked FLOW on the side of the case. Turn clockwise to increase the flow rate. To carry out the adjustment set the sampler up as described with the flowmeter attached upstream of the sampling head using flowmeter stand (01-100890B) with the appropriate flowmeter. The set up is described in separate leaflet hb3175/87 'Sampling Heads and Accessories for High Flow Personal Samplers'.

Check List Before Sampling.

Make sure the battery has been fully charged. Ensure sampling head is correctly fitted with no leaks. If flow rate cannot be obtained with similar conditions to previous occasions suspect leakage.

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4. Maintenance and Servicing.

7.1. Service Department.

Casella's in house service department offers a comprehensive range of repair and calibration services, designed to effect a fast and efficient back-up for all our products. The Service Department is operated under the scope of our BSI registration for products manufactured by us. We will however, undertake the repair of other manufacturers equipment.

For further information please contact our Service Department at our Bedford premises. We will be happy to provide quotations for individual repairs or provide annual maintenance under contract.

Battery.

If the flow rate normally found throughout accustomed head cannot be maintained for a given time then check that:

1. If filter disc is used, is resistance too high? High dust levels, high relative humidity, too small a pore size, may plug the filter after a few hours. Replace with clean filter. If now satisfactory change disc more often.

2. Battery maybe at the end of its service life. To check:- charge the battery for 14 hours, disconnect the battery from the charger and discharge through a 27 ohm resistor
rated at 2 watts or more to 4.4 volts (approximately 51/2 hours). Repeat charge/
discharge twice. If 177mA cannot be produced for 51/2 hours, discard the battery as it is beyond useful life.

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Pump Unit. (Fig. 1).

Note:- Servicing and reassembly of the pump unit should be carried out in a clean and dust free environment. Dust particles under the valves or in the bearing will lower the pump performance and lead to higher operating voltages and current.

1. Undo four screws , remove case lid (Fig. 2). Disconnect and remove battery.

2. Remove two screws marked a (Fig. 2). Remove tube connector from damper outlet and lift out pump unit. Unsolder motor connections from the control board.

Valves.

The valves are made from synthetic rubber.

1. Remove valve chest (09-102158C) with diaphragm clamp plate (09-102157C) by removing four securing screws Z002/16 (Fig. 1).

2. Remove two screws Z002/13 which hold the valve chest to the diaphragm clamp plate and separate the two parts. Valve assemblies are retained in the valve chest by the
O ring seals (O/106/1).

3. Note the orientation of the valve assemblies so that they can be correctly reassembled.

4. Remove the O ring (O/002/1) from the ends of the valve retainers (09-102160A)
from the ends of the valve retainers (09-102160A). Push the valve retainers through the valve seat (09-102159A) to remove valve (01-101189A).

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5. Clean valve seat and make sure that the valve face is smooth and unmarked. Check that new valves have no rough or frayed edges which may result in leakage. Rinse the valves in methylated spirits to remove any trace of mould release agent and very lightly dust with fine talc before assembly.

6. Refit the valve and retainer to the valve seat and fit the O ring (O/002/1) over the retainer until it engages under the shoulder of the stem. The retaining force on the

valve can now be adjusted by gentle pressure in the appropriate direction and should be such that the shoulder under the head of the retainer sits gently on the upper surface of the valve, so that the valve can just rotate. Excessive initial force on the valve will cause high current consumption.

7. Reassemble in to valve chest ensuring correct orientation of valves. Suction valve assembly adjacent to the uppermost. Discharge valve assembly has the valve facing downwards. Ensure O rings (O/016/1) are fitted.

8. Reassemble diaphragm clamp plate to valve chest and refit the assembly to the motor mounting with screws (Z002/13).

Performance Checks (Before Replacing).

Leak Check.

1. Valve chest securing screws not tightened.

2. Pump diaphragm may have failed.

3. Valves may not be correctly tensioned.

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Remove valves and examine seating and valve tensions for faults. Examine pump diaphragm for splits and the security of the diaphragm disc (09-102161A).

Note:- Do not block the inlet or outlet valve for more than 5 seconds at a time.

Pump Diaphragm (Fig. 1).

1. Remove valve chest with diaphragm clamp plate by removing four securing screws.

2. Loosen screw SG502. Pull eccentric (01-102229A) and bearing (BRE35) from motor (104056B) shaft. Loosen screw (Z002/16) on motor mounting (09-10216B)
to release the motor.

3. Lift out the connecting rod (09-102162B), diaphragm (09-102164B) and diaphragm disc (09-102161B) assembly.

Note:- The diaphragm disc and the diaphragm are secured to the connecting rod by the push fit peg on the diaphragm disc and a small amount of Evostick or plastic cement. To replace the diaphragm it should be possible to carefully prise the components apart.

If the locating pin is broken in this operation it will also be necessary to replace both the diaphragm disc and the connecting rod.

4. To fit a new diaphragm check for perforations by holding it to the light and carefully stretching the rubber. Rinse the diaphragm in methylated spirits to remove any trace of mould release agent or grease from handling.

Note:- The diaphragm should be assembled with the convolution facing towards the connecting rod.

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5. Apply a small amount of adhesive (Evostick or plastic cement - not super glue) to the hole in the face of the connecting rod upper disc. Push the components together ensuring that the diaphragm rubber strays central and is not distorted. It should finally be gripped tightly at the radial edge of the diaphragm disc and connecting rod upper disc.

6. The bearing (BRE35) is a press fit on to the eccentric and should be replaced with a new bearing taken directly from its sealed package.

7. Refit the diaphragm/connecting rod assembly and locate on to the motor mounting ensuring that the outer sealing rim of the diaphragm fits in its groove. Ensure that the shouldered face of the connecting rod bearing adaptor is adjacent to the motor mounting (Fig. 1).

Refit valve chest/diaphragm clamp plate assembly and tighten securing screws to just hold the diaphragm in position. Refit motor and clamp in position. Refit motor and clamp in position. Fit eccentric and bearing on to motor shaft and push bearing into the connecting rod housing against the shoulder and tighten screw (SG502).

8. Connect the pump to the damper and run at low speed and while it is running tighten the valve chest/diaphragm assembly to the motor mounting. This allows the diaphragm to adopt its natural position and avoid any twisting forces.

Operational Check.

The following equipment is required: flowmeter, U tube, water manometer with moisture trap, restictor valve and variable d.c. power supply giving voltage and current readout. Connect the pump to the damper and the damper and the damper inlet by means of a water manometer and to a restrictor valve through to the sampling head and flowmeter. Float type flowmeter (CM353) and stand (04-100890B) or bubble meter Casella 5000.

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Set the power supply to minimum voltage and current limit to 200mA. Adjust the test rig and power supply to give a flow rate of 2 litres/min. at 40cm H2O. The voltage should be less than 3.6 volts at a current of less than 130mA.

If unable to achieve this performance:

For high voltage:

1. Check for leaks using test rig.

2. Check that diaphragm is assembled tightly to the connecting rod.

3. Check the valves for leakage, this can be done by using the 'u' tube manometer.
Leakage could be due to valve retaining force being to low, apply pressure to head of retainer and move small 'o' ring to increase retaining force. Valve surfaces or valve seat surfaces imperfect, discard and replace.

For high current:

1. Poor alignment between eccentric, bearing and connecting rod components.

2. Adjust bearing position for minimum current.

3. Valves too tight, relieve retaining force.

4. The motor body can sometimes be rotated in its housing and the position of the eccentric on the motor shaft can also be adjusted to give its natural alignment with diaphragm centre line to affect a reduction of current consumption of as much as 10mA.

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Adjust the motor and eccentric position for lowest current at 2 litres/min. at 40cms H20.

Motor. (Fig.1).

This is not repairable. New motors of the same type (104056B) can be supplied.

1. Removal of motor only as detailed in previous section.
Motor is removed with eccentric.

2. Loosen grub screw (SG502) and remove eccentric.

3. Connect motor to adjustable DC power supply, set at 6V current limit 50mA current consumption should be 18mA. If figure is a lot higher, motor has failed and should be replaced.

5. Calibration.

Electronic Control Circuit.

If the pump does not run, carry out the following checks:

1. That battery volts appear at the input terminals of the control board. For this the control board will have to be removed from the case lid. Undo two screws (Z002/65) (Fig. 2).

2. That a voltage appears at the motor terminals. If no volts at the motor terminals the sampler should be returned for repair. The electronic control board is not user serviceable unless specialised equipment and service personnel are available.

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To set up the electronics for the first time after service or pump replacement, carry out the following procedure:

1. Set up the power supply to 4.7V at 300mA and connect to the battery connector. Turn VR4 full anti-clockwise and switch pump on. Slowly reduce the supply voltage and check that the yellow LED lights at between 4.55V to 4.65V.

2. Continue reducing the supply and check that the pump switches off at between 4.10V to 4.25V.

Flow Control Set Up Procedure:

3. Connect the pump inlet port to the test rig. Set supply to 4.6V. Turn the pump on and adjust the flow control pot (VR2) for 1 litre/min. at 10cm H2O. Increase the pressure drop to 40cm H2O.

3a. If flow increases above 1.05 litres/min. (circuit over-compensating).

Increase the flow slightly by turning VR1 anti-clockwise and then decrease the flow back to 1 litre/min, by adjusting VR2 (anti-clockwise). Re-check the change in flow over the 10-40 cm H2O pressure drop range. Repeat these adjustments until minimal change in flow is achieved.

3b. If flow decreases below 0.25 litre/min. (circuit under compensating).

Decrease the flow slightly by turning VR1 clockwise and then decrease the flow back to 1 litre/min. by adjusting VR2 clockwise). Re-check the change in flow over the 10-40cm H2O pressure drop range. Repeat these adjustments until minimal change in flow is achieved.

4. Set the flow control pot (VR2) for 2 litres/min. at 10cm H2O.

4a. If flow increases above 2.1 litres/min. (circuit over-compensating):

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Increase the flow slightly by turning VR3 anti-clockwise and then decrease the flow back to 2 litres/min. by adjusting VR2 (anti-clockwise). Re-check the change in flow over the 10-40cm H2O pressure drop range. Repeat these adjustments until minimal change in flow is achieved.

4b. If flow decreases below 1.9 litres/min. (circuit under compensating).

Decrease the flow slightly by turning VR3 clockwise and then increase the flow back to 2 litres/min. by adjusting VR2 (clockwise). Recheck the change in flow over 10-40cm H2O pressure drop range. Repeat these adjustments until minimal change in flow is achieved.

When the correct compensation has been achieved at 2 litres/min. return to step 3 and re-check the compensation at 1 litre/min. It maybe necessary to repeat steps 3 and 4 several times to ensure that the flow remains within ± 5% at both flow rates
(1 litre/min. ±0.05 litres/min) and (2 litres/min. ± 0.1 litres/min).

5. Set the flow control pot (VR2) to minimum , the flow should be 0.45 litres/min. If not adjust VR1 slightly. Set flow pot for 0.5 litres/min. Check that a 10-35cm H2O change in pressure drop does not alter the flow by more than ±0.075 litres/min.

6. Set the flow control pot (VR2) to minimum , the flow should be 0.45 litres/min. Check that a 10-35cm H2O change in pressure drop does not alter the flow by more than ±0.03 litres/min.

7. Set the flow control pot (VR2) for 2 litres/min at 40cm H2O. Check current is less than 145mA. Increase pressure to 44cm H2O and adjust vr4 until the red LED just switches on. The pump should stop running after 8 seconds and the red LED should remain on.

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8. Set the flow control pot (VR2) for 2 litres/min at 40cm H2O. Check current is less

than 145mA. Increase pressure to 44cm H2O and adjust VR4 until the red LED just comes on. The pressure drop should be 40cm H2O or greater and the flow rate should still be within ±0.05 litres/min.

9. The counter should display the time in minutes since the pump was connected to the supply.

10. Disconnect the power supply and connect the battery to the harness. Check that the display comes on.

Charging Socket. (Fig. 2).

Before removing, note colour wires to each terminal so that when reconnecting correct polarity is observed, also note correct position of socket. Failure to do this could ruin the battery. Unsolder wires from terminals. Remove securing nut and insulating washer D, lift out socket.

Battery Plug and Socket. (Fig. 2).

If battery is removed regularly, for instance if two consecutive 8 hour samples are required, observe that pins engage with sockets when connecting. If pin or socket breaks or wires become unsoldered replace complete plug or socket. To assemble plug or socket, solder wires to pins then insert into moulding. Never solder onto pins when they are inserted, heat affects the moulding. Observe correct pin positions.

Primary Filter (Fig. 2).

If it is necessary to remove filter FM2 for cleaning remove 3 screws B, lift off inlet fitting and gasket, remove sintered bronze filter, clean and replace.

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Ensure that gaskets (8351/6A72) are in place and remain flat when inlet fitting is screwed into place.
After assembly check for leaks. Suction of 10cm H2O not to drop to less than 8.5cm H2O in 15 seconds.

Damper. (Fig. 2).

Purpose of the damper is to smooth the pulsation's from the pump. Diaphragms are fixed with fast setting adhesive, it is not possible to fit new diaphragms in the event of failure.

If leak is suspected carry out suction test as specified above for primary filter fitting. Replace complete damper if leakage is too great.

Battery Charger.

Parts have a long life, we do not recommend any replacement interval. If wires or joints break inside the plug (CP604) on charger or inside the socket (CS803) in charging lead (A8301/1) replace with new parts. Pins should not be resoldered. On assembly solder wires to pins, then insert into mouldings observing correct positions.

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6. Fault Finding.

Your personal sampler is designed and engineered for long and dependable service but as a precision instrument it should be given the best of care.

Typical problems are shown on the accompanying chart. When testing refer to the exploded views contained in the instruction leaflet.

Other than service hints outlined in the instruction leaflet, we recommend factory service by technicians trained and equipped to repair your sampler. Should you wish factory repair assistance, pack your sampler in a carton equal to the original packaging.
Insure to full value and ship pre-paid. Include a letter giving full details with your packing list.

Send to: Casella Ltd
(Service Department)
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Kempston
Beds MK42 7JY

If purchased outside of the United Kingdom, please return to your distributor.

Please note:
The contents of this Manual are subject to change without notice.

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7. Spares List.

When ordering from the list below, quote the reference number:

TU103	Connecting tube (1 Metre).
B8313/Z	Battery (4 cell complete with socket)
ES2	Battery packing strip (0.08 Metre)
B8358/z	Charger (4 cell battery) single outlet
04-100970D	Charger (4 cell battery) five outlet

When ordering from the list below prefix with reference number 04-103063B:

Pump. (Fig. 1.).

BRE35	Bearing	
104056B	Motor	
O/002/1	Valve retainer	
O/016/1	Valve seat sealing ring	
SG502	Eccentric to motor shaft screw	
Z002/13	Diaphragm clamp plate to valve head assembly.	
Z002/16 motor mounting	Diaphragm clamp plate to valve head assembly to screw	
101189A	Valve disc	
102229A	Eccentric (2.6mm stroke)	
102214A	Bearing adaptor	1off
102216A	Motor mounting	1off
102157C	Diaphragm clamp plate	1off
102158C	Valve head	1off
102159A	Valve seat	2off
102160A	Valve retainer	2off
102161A	Diaphragm disc	1off
102162B	Connecting rod	1off
102164B	Diaphragm	1off

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Spare Parts.

Pump in case (Fig.2).

CP604/CS901/2*CP605	Plug from jack socket
CS803/CS901/2*CS804	Socket from battery
CS1	Charging socket
SW51	ON/OFF switch
GC106	Inlet cover
FM2	Inlet filter
O/004/1	Lid screw retainers
O/010/1	Inlet damper seal
SM1830/8	Inlet fitting to case (damper) screw
SM2230/8	Belt clip to case screw
SM2258/8	Lid to case bottom screw
SM912/8	ON/OFF switch to case screw
NUM160	ON/OFF switch to case nut
Z002/65	Pcb to case lid screw
Z24CZ	Pump to case screw
TU114	Connecting tube pump to damper
SP104	Tube support spring pump to damper
7576/A28	Belt clip
8351/6A72	Damper to case gasket
8351/6A73	Inlet fitting
B8351/7	Damper
102211C	Pump assembly complete with motor
103179A	Case and lid complete with labels
103067C	Complete pcb assembly

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Accessories.

HK2 (Hexagon wrench)	Eccentric to motor shaft
HK304	Flow adjustment

Service Hints:-

Symptom:- Pump does not run (green LED illuminated).

Possible cause:-	**Service Hint**
Battery fully discharged.	Replace with fully charged battery.
Wiring loom disconnected at some point.	Locate and resolder.
Fault on joint.	Replace circuit board.

Symptom:-Pump does not run (green LED illuminated).

Possible cause:-	**Service Hint.**
Eccentric bearing seizure.	Replace bearing.
Motor shaft seizure	Replace motor.

Symptom:-Motor runs but pump inoperative.

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Possible cause:-	**Service Hint.**
Grub screw securing eccentric to motor shaft loose.	Re tighten

Symptom:- Pump runs but no air drawn.

Possible cause:-	**Service Hint.**
Diaphragm rubber split.	Replace.
Pulsation damper membrane split.	Renew pulsation damper.
Flow potentiometer on bottom setting.	Re-adjust.
Tube between pulsation damper and valve chest split or disconnected.	Replace.

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Symptom:- Pump runs but cannot achieve desired flow rate.

Possible cause:-	**Service Hint.**
Leak on pump assembly.	Locate and correct.
Dirt under valves or valves damaged.	Replace.
Inlet filter clogged.	Remove and clean.
Flow potentiometer inoperative	Replace circuit
board.	
Symptom:- Cannot obtain full shift working even when pressure drop does not exceed 40cm H20 at 2 litres/min.	
Possible cause:-Incomplete charge.	Recharge.
Battery below capacity.	Fully charge and
check voltage, should	
	be 4.8V-5.4V. If
below check output	from charger:-
should be 110-125mA.	
	If output correct
replace battery.	
High current consumption due to	Locate and correct.
mechanical defect in pump.	

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8. Specification.

Flow range: 0.5 to 2.5l/min
Flow Control Accuracy: +or - 5% of flow setting
Nominal Battery Setting: 4.8v
Run Time : at least 8 hours
Operating temperature: 0 to +40c
Timer Accuracy: 0.01% in 24 hours
Dimensions: 120*74*50mm
Weight: 500g

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9. Optional Accessories.

B8358/Z Battery charger.
B8313/Z Spare battery.

10. Warnings.